IN THE UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF PENNSYLVANIA

Charles Krik, Plaintiff, v. BP Amoco Chemical Co., et al., Defendants.	Case No. 01 MDL 875 Case No. 11-CV-63473 *Trans. from IL-ND Case No. 10-07435*

EXPERT OPINION OF RADM DAVID P. SARGENT, Jr. USN (Ret.)

I am a retired Rear Admiral of the United States Navy, in which I served between 1967 and 1999. I began my active Navy career in 1967 after receiving a Bachelor of Science degree in Mechanical Engineering from Cornell University and receiving a commission in the Navy through the Naval ROTC program. Upon commissioning in the Navy, I attended the Pacific Fleet Engineering Officer's School in a course focused on the operation and maintenance of engineering plants of World War II era steam propulsion warships. In 1974, I received a Master of Mechanical Engineering degree from the Naval Postgraduate School, Monterey, California. In addition, I am a licensed Professional Engineer (Mechanical) with extensive operational experience in ship engineering, ship maintenance and at-sea operations, and I am a Navy Certified Acquisition Professional.

My assignments from 1967 until 1988 were primarily involved with the operation and maintenance of Navy warships. Thereafter, I held a variety of program and technical management positions in the Naval Sea Systems Command program offices where I was responsible for the design, construction, fleet introduction, in-service support, and modernization of various classes of warships. Upon selection to Rear Admiral in 1994, I was assigned as Commander, Naval Surface Warfare Center, a diverse organization of research laboratories and engineering stations responsible for research and development of all technical aspects of Navy surface ships and submarines. My final assignment before retirement in October 1999 was as Program Executive Officer (PEO) for Aircraft Carrier, Expeditionary Warfare and Auxiliary ships. In that position, I had overall responsibility for all matters relating to both the technical and programmatic details of design, construction, delivery and support of both new and in-service aircraft carriers, expeditionary warfare and auxiliary ships of the Navy.

I am now the President of Sargent Enterprises, Inc. which includes several business units: SEI Associates, a consulting business that provides technical and management advice to marine industries; SEI Marine Technologies LLC; a company that operates and maintains various test and demonstration craft for R&D companies involved in developing new equipment and hull forms for future high performance ships, SEI Vistas LLC that is focused on the introduction of innovative durable construction technologies for maritime related uses, and SEI Properties LLC, a business unit involved in the management and renovation of rental properties, I have served for many years in active leadership of the American Society of Naval Engineers (ASNE) and in

2001 was elected to serve as President ASNE, and served two consecutive two-year terms. I continue as an active member of ASNE leadership. I am also a member of the Sigma Xi Engineering Honorary Society, the American Society of Mechanical Engineers, The Cornell Engineering Alumni Association, the U.S. Navy League and several other professional societies. I serve on the Board of Directors of the Maritime Technology Alliance.

I have been asked in this case to summarize the military environment on Navy warships, Navy organization, responsibilities, ship design and acquisition processes and related documentation, the working environment in shipyards that worked on U.S. Navy ships, and the use of asbestos on Navy ships as these subjects relate to Charles Krik. I have been asked to offer opinions specific to the potential for Charles Krik to have been in proximity to asbestos containing materials while serving on active duty in the U.S. Navy from approximately 1954 until 1970.

The Military Environment on Navy Warships is Unique

The military setting on Navy ships is unique and distinct from the civilian environment, and also differs somewhat from that of land based military organizations. All have management structures, but the military command hierarchy of rank is well defined and the accountability and authority of the Navy ship's Commanding Officer approaches absolute. This authority is based in Federal statute and Navy Regulations and Instructions. Over time, there have been evolutionary changes in these to incorporate changing societal values, but the authority of the individual in command remains constant. When routine "orders" are given, prompt and appropriate response is expected. The failure to obey a lawful order is a punishable offense and, depending upon the situation (wartime, national emergency, misconduct), the punishment can be severe. Individual freedoms that are common to civilians are not as universally applied to military members. Civil liberties indeed exist, but they are tempered to the strict Uniform Code of Military Justice and the requirements of individuals serving in the Country's national defense. Military personnel are required to wear uniforms with rank insignia, and to maintain strict physical and grooming standards. Military members ask for permission to leave the presence of a senior in a normal setting, and juniors initiate salutes when in uniform. Although the actual work tasks and duties performed by Navy sailors may be similar to some civilian trades, Navy uniformed personnel are not civilians "doing their job."

The normal day in the military also differs dramatically from the civilian environment. Whereas civilians have a "normal work day" of 8 or so hours and then return to their "private life", in the military the "work day" is 24 hours long. Here again that 24 hour day is unique for Navy personnel on ships for several reasons. First, a warship is the only weapons system in which the operators live within the machine they operate. Armies live in barracks or tents, store their weapons in ammo magazines, and conduct their daily military tasks in locations separate from both of those. On Navy ships, the vessel is the "barracks", the "magazine, the "weapon", and the military "work site" is continuously in motion on the oceans of the world. Thus, sailors on a Navy ship must continuously operate the ship's propulsion system and "hotel services" equipment that make the ship safe and livable, but must also spend a "military work day" focused on training and maintenance of the "weapon systems" to be battle ready. These two requirements are done concurrently on ships through a "watch bill" in which personnel operate the ship on a twenty-four hour basis, and a "work day" of approximately eight hours. The "watch

bill" is typically comprised of four hour "watches" during which the "engineers" operate the propulsion, electrical generating, and other systems that make the ship mobile, safe and livable, the ship's officers and "deck force" stand navigation and ship control watches on the bridge, and the "operations crew" continuously operate the ships radars, communications, and other electronics equipment. There are typically three "watch sections", thus allowing the personnel to be "on watch" for four hours, and "off watch" for eight hours. Those watch sections in an "off watch" status during the daylight hours use that time to accomplish the "military work day" focused on training and readiness of the war fighting equipment. Thus, a typical day for a sailor on a Navy ship includes two four hour "watches" and up to eight hours of "military work". In addition to the concurrent "watches" and "military work", a Navy ship typically conducts "underway replenishment" every three or four days. During these "underway replenishments", warships rendezvous in close formation with Navy oilers, ammunition ships, and food cargo ships and transfer large quantities of fuel, ammunition, and food to that are needed to keep the ship operating and battle ready. These "underway replenishments" typically take three to four hours to complete, and require "all hands" to be involved to operate the special equipment and to handle the food, ammunition, and cargo coming aboard. These "underway replenishments" can occur at anytime of the day, and are often done in the middle of the night. Therefore, a Navy sailor's "typical work day" is very busy with "watches", "work", and "special evolutions" such as replenishment.

Navy Warships are Unique and Complex

Warships must be designed to meet very demanding performance requirements such as high speed and firing of weapons, the ability to safely carry and employ a vast array of explosives and ammunition, the ability to operate for long periods at sea without support or replenishment, and do all these missions both in peacetime and in combat.

Navy warships are some of the most complex machines ever designed and constructed. They are high-speed, floating, heavily armed communities that must support hundreds of crew members and a vast array of complex systems for months at sea. Ships are the only machines sufficiently large, complex and mobile that the operators must live inside the machines they operate. Thus, warships of all sizes and types contain all the facilities of a community plus multiple the armaments and ammunition. Major characteristics and capabilities include a sturdy and survivable hull form, high performance propulsion systems, electrical power generation to support all needs, fresh water distilling systems, food storage, preparation, and eating spaces as well as clean up, living spaces, laundry services, medical spaces, library, firefighting and damage control capabilities, and many other services.

Navy warships must be designed to operate effectively in very harsh and hostile environments, to survive battle damage and fight again, and to meet demanding speed and maneuvering requirements. Over time, the specific types of enemies, weapons and combat which Navy ships must face have changed, from a focus on surface-to-surface combat involving heavy guns to greater use of aircraft and missiles. These changes have created fundamental changes in the design and construction of Navy vessels.

Beginning in and following World War II, the aircraft carrier became the most significant type of surface ship. An aircraft carrier must use high speed to create wind over the deck to launch and recover aircraft. The result was an overall increase in the speed demanded of Navy vessels of all types, whether carriers or the support and escort vessels that accompany them. To meet these demands, Navy designers had to develop significantly higher horsepower propulsion plants. It was also imperative that this increased power be achieved without significant increase in either the size or the weight of the propulsion plant, since increased size and weight would require even more horsepower.

The unique aspects of Navy warship design and development placed other requirements on the Navy establishment. Since there was no U.S. industry that either designed or assembled these high performance propulsion plants, the Navy itself had to undertake the design of these complex and state-of-the-art warships, and had to develop ways to verify the performance and reliability of these new designs. To accomplish this, the Navy maintained an engineering establishment with many different engineering specialties. The Navy had the most diverse and advanced engineering workforce in the nation. Additionally, verifying the performance of these new propulsion designs required that the Navy engineering organization build large shore-based laboratories in which they assembled and operated prototypes of these propulsion plants. These prototypes served many uses including verifying performance, validating reliability, and developing optimum operating procedures.

Navy Vessels – Concept to Operational – The Process

Cost and Feasibility Studies

Prior to the 1940s through the 1970s, the design of a Navy warship started with the establishment of Navy war fighting requirements at the national level. Examples included requirements such as the need to ensure that sea lanes in international waters cannot be denied by an enemy, the need to detect and neutralize hostile ships, submarines, and aircraft that might threaten U.S. or allied coasts, the need to transport and operate aircraft near enemy territory, and the need to transport and debark Marines anywhere in the world. From requirements such as these, various ship concepts were formulated.

Rigorous feasibility studies were done on these concepts by both seasoned Navy operators and by experienced ship engineers and designers to validate and mature the concepts, and to develop initial cost estimates for budgeting and congressional funding requests. A final ship concept design emerged, describing such parameters as approximate physical size and displacement of the ship, what weapons and sensors would be used aboard, what speed it was required to achieve, what range it must be able to achieve without refueling, and how long it must operate at sea without replenishment. Typically, it took a year or more to progress from a defined new warship requirement set to an agreed-upon concept design to meet those requirements.

Preliminary Design

The next step in the creation of a new warship during the time periods in question was the conversion of the concept design into a preliminary design package that contained sufficient

details of the structure and all ships systems to allow engineers to verify that the ship would meet established requirements. During preliminary design Navy engineers determined all equipment arrangements, the weight and stability of the ship, a detailed understanding of the ship's displacement and powering requirements, and a much better cost estimate. Work included investigation of details such as identification of what materials and technologies existed or could be developed in time to achieve the performance of each system, and ensuring that these technologies and design details could in fact be manufactured and integrated into a completed warship were considered and addressed.

The preliminary design phase was accomplished by dividing the very complex ship into many groupings and sub-groupings such as hull design, propulsion, electrical, deck equipment, messing and berthing, medical, navigation, weapons, sensors, and auxiliary systems to name just a few. During this preliminary design phase, engineers had to develop and document the performance, configuration, and location of each system and piece of equipment that is required to meet the overall ship performance requirements.

The preliminary design also had to comply fully with extensive Navy warship design General Specifications and other design guidance developed over many decades of experience. Examples include aspects such as how much damage the ship must be able to experience and still remain operable, what levels of shock from battle damage equipment must withstand and remain operational, and what fire fighting and damage control capabilities must be included in the design. At the completion of the preliminary design and related documentation, the Navy was confident that the ship and all included systems and equipments will function as designed and would meet the war fighting requirements.

Although the time to develop a preliminary design varied greatly depending on the size and complexity of the warship, typically for a destroyer-type warship, the preliminary design required six months to a year and thousands of man-years of engineering work.

Development of the Contract Design package:

The next phase in progressing from a ship design to an operational warship was the contract design process, in which the preliminary designs were converted into documentation of proper format and sufficient details for use in the government acquisition contracting process. In essence, this effort was to "design" the procurement contract.

The complex ship systems and subsystems described in the preliminary design were typically comprised of a myriad of individual mechanical and electrical components connected together in intricate ways. During the contract design phase, Navy engineers had to confirm that sources exist from which the specified materials, equipments, and consumables could be obtained. However, usually there was no one source from which the Navy could obtain these complex warship systems and subsystems. Rather, sources had to be identified for individual components that can later be assembled into the Navy's complete systems. Thus, the Navy typically had to procure, for each vessel, countless individual components from dozens of individual suppliers and sources. Examples of components associated with just the propulsion systems on Navy warships include specific types of steel and fasteners, pipe and fittings; pumps, valves, turbines,

condensers; electrical motors, generators, and switchboards; gauges, meters, alarms; boilers, condensers and reduction gears. During World War II and well into the 1960s, virtually all equipment that was to be installed in warships was procured by the Navy and provided to the building shipyard as government-furnished equipment.

This detailed designs of all equipment, subsystems, systems, and the entire ship also had to fully comply with the plethora of Navy design guidance developed from previous experience. For example, the Navy set and followed internal standards and requirements regarding such matters as levels of redundancy necessary to preclude single point of failure, standardization of consumables and spare parts amongst different equipments, systems and with other warship classes, crew operating environmental requirements such as temperature, noise, lighting, equipment labeling, standard Navy identification and labeling of decks, doorways, compartments, and equipment, and housekeeping matters such as heating and ventilation, food storage preparation and serving, and laundry requirements.

The contract design package when complete included the entire set of Ship Specifications with detailed design information, the contract plan for procuring all equipment as well as contracting for ship construction, and the multitude of individual requests for proposals that were required to describe every piece of material, equipment and subsystem that had to be procured to allow construction of the warship. The development of the contract design package involved multiple government decisions. Examples include decisions which were subject to various Navy and other federal guidance and regulations, such as Federal Specifications, Federal Acquisition Regulations and Defense Federal Acquisition Regulations.

The Navy developed specifications called, since the 1950s, Military Specifications (MILSPECs) for use in the contract design package. Thousands of MILSPECs were developed for various specific materials, equipment, components, books, manuals, label plates, etc. These MILSPECs presented very detailed descriptions of what the government required when procuring the items covered by the MILSPECs, including requirements such as chemical composition, dimensions, required testing and performance demonstrations, required labeling, packaging and shipping requirements, and similar content. These specifications typically cross-referenced and invoked other specifications.

The Navy maintained the responsibility to develop the MILSPECs and other standards for the manufacture and supply of equipment used in the construction, maintenance and repair of Navy ships. Specifications for any equipment intended for use aboard Navy ships were drafted, approved and maintained by the Navy. Once promulgated, only the Navy could make changes or modifications to those specifications. MILSPECs were prepared by hundreds of Navy engineers highly qualified in specialty areas such as, among many other things, pumps, steam turbines, gas turbines, reduction gears, ship propulsion, and auxiliary equipment.

This specification system was initiated in the 1930s and was expanded in both scope and detail for use in the procurement of the large number of complex warships procured in the World War II timeframe and since. The technical specifications system always included a disciplined revision and change process to ensure technical specifications were kept current and reflected changing requirements, technology, materials, and other related updates. Manufacturers of

components such as pumps and valves procured by the Navy for use in warships were required to comply with technical specifications in all details in order for the Navy to accept the equipments being manufactured, tested, and shipped.

Navy specifications were communicated to vendors such as Crane Co. when the Navy (or private entities, such as shipyards or design professional firms retained by the Navy) issued Requests for Proposal (formerly called Invitations for Bid) for the manufacture or supply of certain equipment. Compliance with the standards and specifications issued for equipment supplied for ultimate use aboard Navy ships was directly monitored by Naval Machinery Inspectors under both of the following divisions: (a) Machinery Inspectors under the Bureau of Supplies and Accounts worked on-site at vendor facilities, such as Crane Co.'s manufacturing facilities; and (b) Machinery Inspectors under BUSHIPS carried out their responsibilities at the shipbuilding yards. The Machinery Inspectors ultimately worked for the Secretary of the Navy or the Secretary of War. These Inspectors exercised primary, front line control and direction over the work performed for the Navy by original equipment manufacturers, regardless of whether the equipment was being constructed or supplied pursuant to a Navy or private contract. Crane Co. equipment could not have been installed aboard Navy vessels unless that equipment was first determined by the Navy to be in conformity with all applicable Navy specifications.

The incredible level of detail contained in these specifications is necessary to ensure complete and common understanding between the government and vendors of what it is the government is requires and is committing to pay for, to ensure commonality across systems with similar components, and ensure that replacement parts, equipment and consumable materials, some provided by different manufacturers, will all perform as desired. An acquisition contract typically invokes many different MILSPECs, various technical documents such as drawings prepared by the Navy's Bureau of Ships. Taken together, the contract and the incorporated materials present all details of what the Navy requires. It is through this detailed acquisition process that misunderstanding, or rejection at the time of government acceptance inspection, is avoided. This process also minimizes contract disputes between the government and industry vendors.

Developing the contract design package is comparable to the effort required if a team was to simultaneously develop the detailed designs and contracts to construct a small city including all the required services such as utilities, hospitals, restaurants, and the like. Because of the complexity and thoroughness required, development of the contract design package for a warship such as a destroyer typically took two years or more to complete, with thousands of man-years or effort from engineers, logisticians, contract and legal specialists.

For many vessels, the Navy retained experienced naval architecture and marine engineering firms to act as "Design Agents" under contract to the Navy. These Design Agents assisted in both the creation of the Navy contract design package and the interface with construction shipyards and equipment suppliers after aware of construction and procurement contracts. Use of Design Agents provided the Navy with a common means of expanding its own in-house technical staff. Design Agents both acted under and imposed on equipment suppliers strict Navy specifications. In short, the task of the Design Agent was to ensure completion of work in

accordance with all applicable specifications to the same extent that would have occurred had the Navy supervised the work directly.

Detailed Design

From the 1940s through the 1970s, the next step in the creation of a new warship was the conversion of the contract design into detailed design package that contains sufficient details of the structure and all ships systems to allow the building shipyard to build the ship and integrate all specified equipment in accordance with Navy requirements and specifications. The detailed design was typically accomplished by the construction shipyard – whether a Navy yard or a private yard – after the construction contract was awarded. During this detailed design phase, engineers had to develop and document in detail the exact location, mounting details, and interface details of each system and piece of equipment in the total ship. Even where not performed by Navy personnel, the detailed design was also overseen by Navy representatives.

Warship Construction

The final phases in getting the warship operational included the construction, testing and trials, and acceptance by the Navy. During World War II and up until the mid-1960s, some Navy warships were constructed at Naval Shipyards and others were constructed at private shipyards under Navy contract and supervision. Once the Navy selected a construction shipyard, that shipyard was required to comply with all details of the contract in the procurement of material and equipment, the construction of the ship, the testing of equipment, subsystems, and systems and the demonstration to the government that all systems functioned properly. All construction and testing was overseen on a daily basis by the on-site Navy Supervisor of Shipbuilding team. Formal acceptance of the completed warship was recommended by the Navy Board of Inspection and Survey only after the members of the Board had witnessed successful sea trials of all systems.

Construction of even a relatively small warship such as a destroyer typically took three to five years, with larger ships requiring somewhat longer. During World War II, the construction time for warships was dramatically reduced through the concerted efforts of both the Navy and the industries involved. The Navy working with the War Production Board instituted standardization of warship designs, central procurement of ships' major equipment, propulsion machinery, and ordnance, and allocation of key materials. Industry went to twenty-four hour workdays with multiple shifts, prefabrication and automation of many processes, and multiple other time saving methodologies. The Navy and the U.S. Navy worked closely with the shipbuilding industries and increased the number of shipyards capable of constructing destroyers and larger ships from approximately a dozen in 1940 to around 70 in about two years.

Asbestos and Insulation in the Navy

As described above, the Navy requirements for aircraft carriers and other warships of World War II and later included the need for significantly higher speeds than previously. This high speed required was achieved by the design and development of sophisticated high-pressure steam

propulsion systems. Steam pressures of 600 pounds per square inch and the ability to superheat the steam to 850° F became the norm.

The key to meeting this high horsepower demand was the development by the Navy of much high pressure, superheated steam propulsion plants. With the increased pressures came greatly increased temperatures and thus the need for much improved insulation technologies, both for plant efficiency and for operator comfort and safety. These "high power density" propulsion plants increased the operating temperatures of machinery and piping, and they created a need for greatly improved thermal insulating and lagging materials. The Navy maintained significant expertise in the important areas of heat transfer and insulation. As a consequence, the thermal insulation needs associated with various equipment and systems was a significant issue in the design of Navy vessels from a number of perspectives. Thermal insulation served a number of important functions, as set forth, for example, by the 1947 version of the Navy's BUSHIPS Manual, a technical reference for Navy engineers, where Chapter 39 was devoted entirely to "Thermal Insulation":

> REASONS FOR INSULATING
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> (1) In every power plant there is a heat loss from all heated surfaces and a heat flow to all cooled surfaces. Heat flow may occur in three ways; by conduction, by convection, and by radiation.
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> (2) Conduction is the heat flow from one part of a body to another part of the same body, or from one body to another with which it is in physical contact, without displacement of the particles of the body. This manner of heat flow is most important in insulation as it is the low conduction which results in the greatest temperature differential between a hot insulated surface and the atmosphere (as in steam piping insulation), or the relatively warm atmosphere and a cold surface (as in refrigerating plant insulation). Heat transfer from insulated pipes or large blanketed or cemented surfaces (turbines, evaporators, etc.) to the outer surface of their lagging is included in this mode. Conduction is associated with solids and comparison of materials in this respect is measured by a factor called the "thermal conductivity" which expresses rate of conductivity in British thermal units (B.t.u.) per inch of thickness per hour per square foot of area per degree Fahrenheit temperature differential.
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> (3) Convection is the transfer of heat from one point to another within a fluid, gas or liquid, by circulating or mixing of one portion of the fluid with another. These currents are produced by warm fluid being displaced by heavier cold fluid. It is of interest to note that convection reduces the effectiveness of air space insulation unless such space is very small.
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> (4) Radiation is the method of heat transfer by which a hot body gives off energy in the form of radiant heat which is emitted in all directions. Radiant heat, like light, travels in straight lines and with the speed of light. The surface condition greatly affects the ability of a body to radiate heat. Dull, dark, rough finished surfaces are the best radiators. Conversely, bright, shiny, smooth surfaces are good heat reflectors.

(5) In order to minimize the transfer of heat from or to a body or surface which is hotter or colder, respectively, than the surrounding atmosphere, thermal insulation is applied. This thermal insulation is a material or materials of low thermal conductivity. (See par. 39-2 (2).) While increasing the economy of the plant, thermal insulation also reduces the quantity of air necessary for ventilating and cooling requirements and prevents injury of personnel due to burns from contact with hot parts of apparatus. It also insures more uniform heat distribution within equipment. Another function of thermal insulation is to prevent "sweating" of cold surfaces on which atmospheric moisture condenses thus causing undesirable dripping as well as accelerated corrosion of the metal. Insulation must be sufficiently effective to reduce heat losses and lower surface temperatures to a degree which will permit habitable conditions in a specific space or compartment.

Due to the importance of heat transfer and insulation in Navy propulsion plants and aboard Navy vessels more generally, the Navy maintained significant expertise in these areas. The BUSHIPS manual and other documents issued and continuously updated by the Navy contained detailed instructions for the insulation by Navy shipyards or private contractors of various systems and equipment, including, primarily, the miles of piping associated with thermal systems aboard vessels. The Navy's specifications provided detailed instructions as to the specific insulating materials to be used, and also as to the amounts of those materials and the manner in which they were to be applied.

A 1946 article entitled "A Health Survey of Pipe Covering Operations in Constructing Naval Vessels" summarized the extent of and reasons for the Navy's use of asbestos-containing insulation during World War II:

> The chief reasons for the wide use of amosite felt and pipe covering in naval work are its low thermal conductivity, light weight, strength, and refractoriness. When the felt and pipe cover were first developed, we were still building vessels under the Washington Treat of Limitations in Tonnage, and every pound saved meant that much more armor, guns or ammunition for a given displacement, to say nothing of more economic operation for the weight involved in insulation.
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> Amosite pipe covering weighs about 14 pounds per cubic foot, with a temperature limit of 750 degrees F. as compared to magnesia with a weight of 16 pounds per cubic foot [. . . .]
>
> The development of amosite felt started in 1934 when a need existed to secure a thermal insulation lighter in weight and thermally more efficient than the materials (blocks and cement or asbestos blankets) which were then being used in destroyer turbines. . . . Originally amosite was used only for turbine insulation, but it proved so satisfactory that its field of application enlarged to include insulation of valves, fittings, flanges, etc. From the initial destroyer, it has been used on almost all the destroyers built since that time and on all other combat vessels built since before the War.

> Pipe covering was a later development in late 1935 and early 1936. Due to the manufacturing problems involved, it took a longer time to evolve into a satisfactory shape, and its first use on naval vessels was in 1937. Since that time its use has spread markedly and it was used on the great majority of naval combat vessels built during World War II.

The Navy's dictation of the methods and materials for insulation of thermal systems took various forms. As noted above, these included serial iterations of the BUSHIPS Manual's Chapter 39 on "Thermal Insulation." The Navy also prepared and imposed upon Navy design engineers General Specifications for Machinery for Vessels of the United States Navy. Those specifications included an entire section – Section S39 – governing "Thermal Insulation for Machinery and Piping." Beginning in 1962, the Navy began issuing a Military Standard intended "to amplify the general requirements for insulation of piping, machinery, uptakes, and mechanical equipment covered in the General Specifications for Ships of the U.S. Navy or in ships specifications.

The Navy and/or its Design Agents prepared for the builders of Navy vessels detailed drawings and plans showing the precise methods and materials for insulation of various systems and equipment. Those documents – referred to as "Insulation and Lagging Schedules" – implemented the overall requirements of the General Specifications, and they provided the actual instructions to the personnel applying insulation as part of an integrated system of temperature control and energy conservation consistent with the Navy's needs in the operation of its vessels. These plans are referred to as "Insulation and Lagging Schedules." They were typically developed for each class of warship. The Insulation and Lagging Schedules included details on the materials to be used, the thickness, installation procedures, and finishing details for tens or even hundreds of tons of thermal insulation materials to be applied by Navy and private shipyards. Once the Navy selected a construction shipyard, that shipyard was required to comply strictly with all Navy specifications, plans and drawings in the application of insulation and lagging to systems and equipment aboard Navy vessels.

Throughout the World War II and post- World War II era, the vast majority of thermal insulating materials used aboard Navy vessels contained asbestos. Asbestos-containing materials offered many advantages over previous or alternative materials in meeting these needs. They were relatively light compared with previous materials, had better insulating properties, did not require excessive thicknesses in application, were more durable and were resistant dissolving in or absorbing salt water. The materials also served as fire protection in an environment in which fires were an ever-present danger.
Thus, the use of asbestos in thermal insulation allowed the Navy to design and field propulsion systems that met the demanding war fighting requirements of World War II and later. The importance of asbestos to Navy warships is attested to by the fact that it was assigned a high priority in the U.S. government's critical materials allocation process. Asbestos was in short supply during World War II, and its use was controlled through the War Production Board process. A very large percentage of asbestos was allocated to the needs of the Navy and U.S. Navy for use in insulation for ship construction.

The Navy's demands for asbestos-containing insulation were extraordinary. For example, the Insulation and Lagging schedules for destroyers of the Navy's *Sumner* and *Gearing* classes – relatively small vessels of which the Navy constructed approximately 200 during World War II – specified nearly 24 tons of asbestos containing thermal insulation be installed. A 1979 Department of the Navy letter recites the following estimates of the quantities of thermal insulation aboard different types of Navy vessels of the 1950s and 1960s:

Destroyer - DD	87,634 lbs
Guided Missile Cruiser - CGN	123,770 lbs
Submarine – SSN	62,465 lbs
Replenishment Oiler – AOR	78,515 lbs
Large Harbor Tug – YTB	6,858 lbs

Larger vessels, such as aircraft carriers and battleships, required multiples of those amounts. Taken as a whole, in both new construction and overhaul, the Navy applied thousands of tons of asbestos materials aboard its vessels from the 1930s through the 1970s.

Due to the complexities of the ship design and construction process, and the global nature of the Navy's approach to selection and procurement of insulation and lagging materials, manufacturers of components such as Crane Co. were not consulted by the Navy with respect to insulation of their equipment. Moreover, they had no control over the types and quantities of insulation products to be used in conjunction with their equipment, nor could they even be certain whether or not any insulation would, in fact, be applied to their equipment due to the variety of circumstances and potential uses of the original equipment once aboard a Navy vessel.

Above and beyond the tens or hundreds of tons of thermal insulation used, other asbestos materials were ubiquitous aboard Navy vessels. These materials included electrical insulating materials, flooring, refractories and sealing materials. Among other things, military specifications for gasket and packing for centrifugal pumps required the use of asbestos-containing materials.

Written Materials Regarding Equipment Supplied to the Navy

Technical specifications referenced in the procurement documents for components such as pumps have, since at least the 1940s, included detailed requirements regarding all written materials supplied with pumps. Manufacturers were required to supply drawings and plans, and at times draft technical manuals for equipment. The applicable specifications included strict instructions regarding the labeling of and packaging of the components themselves, and for all technical documentation that was procured with them.

To achieve its objective of ensuring that, in form and content, the marking on equipment filled the specific informational role, for the specific Navy audience and environment, the Navy developed precise specifications as to the nature of any markings, communication or directions affixed to or made a part of any equipment supplied by OEMs for ultimate use aboard Navy ships. OEMs would not have been permitted, under the specifications, associated regulations and procedures, nor under the actual practice as it evolved in the field, to vary or to deviate in

any respect from the Navy specifications in supplying equipment, including affixing any type of warning or caution statement to equipment intended for installation in a Navy ship, beyond those specifically required by the Navy without prior discussion and express approval by the Navy.

The Navy likewise had precise specifications as to the nature of written materials to be delivered with equipment supplied by OEMs to the Navy. This written material included a variety of formats such as design drawings, system schematics as well as operator reference materials to assist the equipment operators in operating, servicing and maintaining such equipment and to assist the Navy training establishment to develop instructional materials and courses. Through specifications, the Navy required that certain equipment be supplied with a defined number of copies of one or more instruction books or technical manuals. The Navy typically developed these technical manuals by including development of a draft manual as part of equipment procurement contracts. The draft manuals were required to be submitted to the Navy for detailed review and feedback. Once the draft manuals were found to be acceptable to the Navy, a BUSHIPS number was assigned and the manual became an official BUSHIPS document the contents of which were controlled by the Navy. The term "manufacturer's instruction books" that is found in many Navy rate training manuals refers to these Navy developed and approved technical manuals.

Navy personnel or those of the Navy's Design Agents participated intimately in the preparation and review of these instruction books and technical manuals in a standardized format used by the Navy. These manuals included safety information to the extent – and only to the extent – directed by the Navy. Manufacturers of components and equipment were not permitted, under the specifications, associated regulations and procedures, nor under the actual practice as it evolved in the field, to include any type of warning or caution statement in instruction books or technical manuals, beyond those required and approved by the Navy without prior discussion and approval by the Navy. The Navy dictated and, itself or through its Design Agents, reviewed and approved the contents of all technical manuals, including any cautionary language or emphasis. The Navy approached this process for review and approval of technical manuals in an exacting manner. It often created lengthy memoranda detailing word-by-word line edits to the content of technical manuals submitted for approval, including the wording of instructional material and warnings. Review of and comment upon instructional materials by the Navy's Design Agents was similarly detailed.

The reasons for the Navy's detailed control over and review and approval of all written communication regarding equipment it procured was to ensure consistency of that information with the overall goals and priorities of the Navy in its operations. The Navy employed millions of uniformed and civilian personnel aboard thousands of vessels and at hundreds of land-based facilities around the world. The information provided with regard to equipment had to be consistent with the Navy's overall evaluation of the appropriate types and level of information its personnel required to efficiently perform their job responsibilities under a variety of circumstances. In addition, written communications regarding work practices, including safety precautions and equipment, had to be coordinated with the training of Navy personnel, the physical circumstances in which they performed their work, and the tools, protective devices and equipment and other materials available aboard Navy vessels and at Navy installations.

Uniformity and standardization of any communication, particularly safety information, are critical to the operation of the Navy and Navy ships. The Navy could simply not operate safely and effectively if personnel were trained differently, using inconsistent information received from different manufacturers. If every equipment, structural steel and pipe manufacturer were allowed to decide on the need for, and provide its own safety and health warnings (including those concerning asbestos insulation that might be used on or around its product), inconsistent warnings would certainly have resulted. If each were to warn about all the possible substances that might be used on or around its equipment, sailors would quickly become inundated with inconsistent information on a myriad of substances. Therefore, the Navy's detailed specification of what warnings were required, both on equipment and in technical documentation, was logical and necessary.

Asbestos-associated health issues, and the insulation materials with which the Navy associated those issues, were ubiquitous in Navy environments. Tens of tons of asbestos-containing insulation were present in mechanical and other spaces aboard Navy vessels. Consistent with its objective to ensure that all documentation to which its personnel were exposed be thoroughly consistent with its overall training and procedures, the Navy would not have permitted equipment suppliers to place asbestos-related warnings on packaging or containers for pumps or related parts or items supplied during the 1940s, 1950s, or 1960s. Similarly, the Navy would not have permitted equipment suppliers to place asbestos-related warnings in any literature or documentations supplied with pumps for Navy ships during the 1940s, 1950s and 1960s.

In this regard, it is useful to consider the Bureau of Ships Technical Manual. This manual, prepared by the Navy and updated periodically, was intended to provide guidance and information to Navy personnel on various matters. The Manual contained specific chapters covering numerous topics.

A review of examples of Chapter 47 relating to pumps and Chapter 95 relating to gaskets and packing reveals that even when drafting its own manuals governing activities widely known to involve asbestos, the Navy nowhere included any cautionary language regarding – or even any mention of – any potential hazards relating to asbestos. In addition, neither Chapter 39 of the BUSHIPS Manual relating to insulation nor Chapter 48 covering piping (and valves) likewise contained reference to such hazards during the 1940s, 1950 and 1960s. Similarly, the Navy's system-level manuals of the type described above likely did not, even where they pertained to propulsion or other systems on which the Navy required shipbuilders and Navy personnel to install large amounts of asbestos insulation, contain asbestos-related cautions to Navy personnel.

The absence of asbestos-related cautionary language in the Navy's own manuals for equipment or for asbestos-containing materials is consistent with the notion that the Navy did not accept, and did not permit, asbestos-related warnings in technical manuals relating to individual pieces of machinery or equipment, and is fully consistent with my experience that such warnings were not neither sought nor welcome from manufacturers of such items.

Consistent with these objectives, practices and procedures for the design, inspection and procurement of equipment for use on Navy vessels, the Navy would not have permitted Crane Co. or other equipment suppliers to place asbestos-related warnings on packaging or containers

for pumps or related parts or items supplied during the 1940s, 1950s, or 1960s. Similarly, the Navy would not have permitted Crane Co. or other equipment suppliers to place asbestos-related warnings in any literature or documentations supplied with pumps for Navy ships.1940s, 1950s and 1960s.

Navy Organization

Consistent with the sweeping scope of its mission and responsibilities, the Navy is comprised of many different organizations, each of which is specialized in focus, talent and experience. These organizations work together in accomplishing the very complex and unique sequential efforts from the defining of Navy war fighting requirements, designing ships and weapon systems that will meet these requirements, and contracting with industry and other government agencies to procure the vast array of required equipment and materials and to construct and test warships. This diverse Navy organization can be described in four major groupings:

-- Secretary of the Navy (SECNAV) and the Chief of Naval Operations (CNO) Headquarters staffs (CNO staff is referred to as OPNAV)

-- Operational Fleets

-- Technical Bureaus (now called Systems Commands)

-- Staff Corps (Medical, Dental, Legal, etc.)

SECNAV and CNO Staffs

The staffs of Secretary of the Navy (SECNAV) and the Chief of Naval Operations (CNO) are involved in the analysis of national Navy war fighting needs, and the development of specific war fighting requirements that must be met. At a top level for warships, these requirements include such things as the types and numbers of ships needed; the capabilities for these ships such as speed, weapons to be installed; types and numbers of aircraft to be embarked; the range and duration at which these ships must be able to operate independently at sea without replenishment; and the reliability of systems that must be guaranteed in order for the Navy to meets its war fighting mission. These staffs are manned by a combination of experienced uniformed Navy personnel with extensive Fleet experience and career civil servants.

Operational Fleets

The Operational Fleets are the Navy's war fighters who control and operate the various ships, aircraft, and other equipment in the Navy and Marine Corps. There are several numbered Fleets (*e.g.*, Sixth Fleet, Seventh Fleet) with regional geographic responsibilities around the world. These Operational Fleets have always worked closely with the headquarters staffs in the development of Navy warship required capabilities.

Technical Bureaus

The Bureau System was established in 1842 to provide the Navy with necessary technical and management control. By the early 1940s, there were six bureaus:

-- Bureau of Naval Yards and Docks
-- Bureau of Ships (BUSHIPS)
-- Bureau of Supplies and Accounts (BUSANDA)
-- Bureau of Ordnance and Hydrography
-- Bureau of Medicine and Surgery
-- Bureau of Aeronautics

In the 1950s, a Bureau of Weapons (BUWEPS) was formed by merging the Bureau of Ordnance and the Bureau of Aeronautics. In the 1960s the bureau system evolved several times into what are now called the Systems Commands where BUWEPS was divided into the Naval Air Systems Command and Naval Ordnance Command (NAVORD), and BUSHIPS was divided into the Naval Ship Systems Command (NAVSHIPS) and the Naval Electronics Systems Command. In 1975, another reorganization took place in which NAVSHIPS and NAVORD became the Naval Sea Systems Command (NAVSEA). During this organizational evolution the Bureau of Supplies and Accounts (BUSANDA) became the Naval Supply Systems Command.

Navy Staff Corps

The various staff corps of the Navy are comprised of professionals such as doctors, dentists, and lawyers who support all aspects of the Navy in their respective specialties.

The Bureau of Medicine and Surgery (BUMED) has always had a very significant role in both the design and operation of Navy warships, in addition to its fundamental role in the overall health and well-being of Navy personnel. All ships have medical facilities integrated into the design, both for normal medical support of the large crews, and for treatment of battle injuries. Small ships such as destroyers have a modest infirmary space and other spaces that can be converted for medical use while at battle stations. Larger ships have much greater medical capability, with aircraft carriers being fully equipped with several operating rooms for surgery and large hospital wards for sick and wounded personnel.

BUMED also plays a very significant role in the operation of Navy ships. BUMED establishes the medical policies and procedures, both preventive and curative, which are utilized on all Navy warships. Additionally, the crew of each warship includes medical personnel who are involved in preventive medicine, crew training, health inspections, and treatment of ailments and injuries. Small ships such as destroyers typically have one highly trained enlisted hospital corpsman assigned, and large ships have both physicians and hospital corpsmen. Aircraft carriers have numerous medical doctors and surgeons with various specialties.

Responsibilities in Warship Design and Construction

Responsibilities for the various functions associated with warship design and construction in from the World War II period to the 1970s were as follows:

SECNAV and OPNAV Staffs

Working closely with the Operational Fleets and Bureaus, these staffs had the responsibility for defining Navy war fighting requirements, developing concepts of operations and ship concepts, and requesting congressional authority and funding to build war ships.

BUSHIPS

The Bureau of Ships was comprised of a broad assortment of engineers and technical personnel, and was responsible for all technical aspects of Navy warships. Included were the preliminary designs of ships, the detailed design of ships, subsystems and equipment, and development of the contract design package. BUSHIPS, aided by BUSANDA, had the responsibility to develop the contract design package and the myriad invitation for bids required to actually procure and construct the ships. All U.S. Naval Shipyards were under the direct command of BUSHIPS, as were the resident Supervisors of Shipbuilding who performed the same government supervisory functions at civilian shipyards. Thus, BUSHIPS was responsible for both the new construction and future repair and overhaul of ships at both Navy and private shipyards. BUSHIPS and BUSANDA each had on-site Navy inspectors at various vendors' plants that were responsible for verifying that the vendor complied exactly with all provisions of that vendor's procurement contracts. BUSHIPS was also responsible for the design development of equipment repair and maintenance standards and procedures, and for the development of Navy Specs/MILSPECs that related to ships and ship equipment.

Other Technical Organizations

Warships are equipped with many different weapon systems, aviation capabilities, and the accompanying electronic equipment. Therefore, many other Navy and national technical organizations provided support to BUSHIPS in all phases of design and construction. Principal supporting organizations included the Bureau of Ordnance, the Bureau of Aeronautics, and the Naval Electronics Command. Also key in the development and testing of warship propulsion equipment and systems were the National Boiler Test Lab and the Naval Ship System Engineering Station.

BUSANDA

The Bureau of Supplies and Accounts was comprised of a variety of professionals with specialties in areas such as government contracting, logistics planning, financial and business management, warehousing and parts distribution management, etc. BUSANDA, in addition to on-site and continuous support of BUSHIPS and other technical bureaus, also provided all Supply Corps officers to the Operational Fleet. The Supply Corps officers were assigned to both ships and Fleet staffs and were responsible for planning and managing all shipboard messing,

berthing and spare parts management. BUSANDA was responsible for maintaining and managing the vast inventory of spare parts, consumables, documentation, and replacement equipment for the Navy.

Charles Krik's Navy Service and Shipyard Work and Proximity to Asbestos-Containing Products

I have reviewed the documents listed in the table below, and offer the following summary and opinions specific to the potential for Charles Krik to have been in proximity to asbestos containing materials while serving on active duty in the U.S. Navy as a Boiler Technician (BT) and Boilermaker (BR) from approximately 1954 until 1970. My opinions in this case are based on my knowledge and experience as a career Navy officer, degreed and licensed professional engineer, experienced ship engineer and commanding officer, and certified Navy acquisition professional. Each of these opinions is given to a reasonable degree of professional certainty. In reaching my opinions, I have reviewed the documents listed in the table below.

Documents reviewed
First Amended Summons & Complaint
Plaintiffs responses to Interrogatories
Transcript of a Videotaped Deposition of Charles Krik Volumes 1&2 taken on 7/18 and 8/14/11 with Exhibits 1&2

I also referred to the public websites www.navsource.org, and www.hazegray.org that provide some historical information on Navy ships.

From reviewing Plaintiff's Answers to Interrogatories and the deposition testimony of Charles Krik I learned that Charles Krik was born on 17 September 1937 in Braidwood IL. I learned that Charles Krik enlisted in the U.S. Navy in approximately 1954 and served on active duty until approximately 1970. I learned that Charles Krik was a Fireman and Boilerman for approximately four years and became a Boilermaker and advanced to Boilermaker Chief Petty Officer while serving on active duty in the U.S. Navy.

Charles Krik testified that he served on active duty in the U.S. Navy from 1954 until 1970. He also testified that he served as a Boilerman (BT) for approximately 1954 until 1970 and sixteen years as a Boilermaker from approximately 1957 until he left active duty. Charles Krik testified that he was a certified Navy boiler inspector in the latter years of his service and that he served as a recruiter for the last two years of active duty.

The table below summarizes the duty stations at which Charles Krik while on active duty in the U.S. Navy as I learned them from reviewing the deposition testimony of Charles Krik.

Military Service Summary tables for RMC Charles Krik			
Dates	Duty Station	Billet/Job Title	Rate
1954	Enlisted US Navy	Recruit	SR
Approx. 1954-1957	USS SPROSTON (DD-577)	Fireroom	FA-BT
Approx. 6 months 1957/1958	USS JENKINS (DD-447)	Fireroom	BT-BT1

Approx. 1958-1961	USS BRYCE CANYON (AD-36)	Boiler shop	BR1
Approx. 1961-1963	Shore Duty	Brig Warden	BR1?
Approx. 1963	Boilermaker School	Student	BR1
Approx. 1963-1965	USS VULCAN (AR-5)	Boiler Shop	BR1/BRC
Approx. 1965-1966	USS TUTUILA (ARG-4))	Boiler/valve/ AC&R	BR1/BRC
Approx. 1966-1968	Unknown	Boiler Inspector	BRC
Approx. 1968-1970	Port Huron MI	Recruiter	BRC

Charles Krik testified that while serving in *USS SPROSTON (DD-577)* and *USS JENKINS (DD-447)* that he was assigned to a fire room in both ships. He testified that while serving in *USS BRYCE CANYON (AD-36)* and *USS VULCAN (AR-5)* that he was assigned to the boiler shop in each ship and that his duties involved working on various destroyers, service force and amphibious ships that came alongside for repair work.

Charles Krik testified that while assigned to *USS TUTUILA ()* he joined the ship in Norfolk, transited to Vietnam, and was in charge of the shop that worked on boilers, air conditioning and refrigeration systems, and valves on small ships and craft that came alongside for repairs.

Charles Krik testified that while on shore duty between serving in *USS JENKINS* and *USS BRYCE CANYON* he served as a brig warden. He testified that he was a recruiter in Port Huron MI for his last two and one-half years of active duty.

Charles Krik testified that when he was serving in the Navy the rating of Boilermaker was held only by Petty Officers at the E-6 through E-8 pay grades (BRC, BRCS, BRCM).

In reviewing the websites listed above, I confirmed that following.

- *USS SPROSTON (DD-577)* was a steam-turbine propelled Fletcher Class Destroyer commissioned in May 1943.

- *USS JENKINS (DD-447)* was a steam-turbine propelled Fletcher Class Destroyer commissioned in July 1942.

- *USS BRYCE CANYON (AD-36))* was a steam-turbine propelled Shenandoah Class Destroyer Tender commissioned in September 1950.

- *USS VULCAN (AR-5)* was a steam-turbine propelled Vulcan Class Repair Ship commissioned in June 1941.

- *USS TUTUILA (ARG-4)* was a reciprocating steam engine propelled Luzon Class Internal Combustion Engine Repair Ship originally commissioned in April 1944. *USS TUTUILA* was decommissioned in December 1946 and was recommissioned in May 1951.

Opinions: Having reviewed the documents cited above and based upon my familiarity with Navy ships and operations generally and with the ships in which Charles Krik served and worked in particular, I offer the following opinions to a reasonable degree of professional certainty

regarding Charles Krik's work environment and proximity to asbestos containing materials while serving in the U.S. Navy.

1. It would be helpful to review Charles Krik's official Navy personnel records to better understand the details of his Navy career, his duty assignments and his advancement history.

2. Charles Krik's testimony that he served on active duty in the U.S. Navy from 1954 until 1970 is inconsistent with his testimony that he served approximately four years as a Boilerman and sixteen years as a Boilermaker while in the Navy.

3. Based on Charles Krik's testimony that the rating of Boilerman was held only by Petty Officers at the pay grades of E-6 and above, it is my opinion that he advanced to Boilerman First Class (BT1) while serving in *USS SPROSTON* or *USS JENKINS.*

4. Charles Krik's assignment as a Fireman Apprentice (FA), Fireman (FN) and Boilerman serving in the fire rooms in *USS SPROSTON (DD-577)* and *USS JENKINS (DD-447)* placed him in a working environment in close proximity to many piping systems and other propulsion equipment that the Navy specified be insulated with asbestos containing thermal insulation.

5. As a Boilermaker serving in the boiler shops in *USS BRYCE CANYON (AD-36)* and *USS VULCAN (AR-5)*, Charles Krik would have been working in the engineering spaces in steam propelled Navy ships that were being tended and would have been working in close proximity to various systems and equipment that the Navy had required be insulated with asbestos containing thermal insulation.

6. The U. S. Navy required the application of large amounts of asbestos containing insulation and lagging to piping, valves and other equipment located in the engineering spaces in the ships in which Charles Krik served and worked.

7. The application of insulation to piping, valves and other equipment on U.S. Navy ships, if insulated at all, was done after the piping, valves and equipment had been installed and hydrostatically tested. The installation of insulating material was done by the building shipyard during construction or the repair shipyard during shipyard overhauls and repair periods.

8. The manufacturers of equipment such as pumps, valves, and piping had no influence on whether the U.S. Navy would insulate the equipment after installation, or on what insulating materials the U.S. Navy specified.

9. The very large majority of asbestos containing material onboard warships such as those in which Charles Krik served was the asbestos containing thermal insulation used by the U.S. Navy on propulsion and auxiliary steam piping and equipment.

10. The vast majority of that insulating material was in the engineering spaces, but some was also utilized throughout the ships on systems such as hot water and steam for cooking and heating and other hotel systems.

11. The total amount of asbestos material contained in gaskets and packing aboard USN ships such as those in which Charles Krik served was very small compared to the extensive amount of asbestos contained in the Navy specified thermal insulation.

12. Manufacturers of equipment such as Buffalo Pumps typically had no control over, knowledge of nor visibility into what the Navy did with the equipment after receipt, when or how it was maintained and overhauled, or what replacement consumable materials such as gaskets and packing the Navy used.

13. The U. S. Navy, not original equipment manufacturers, specified in detail the content and technical details of all gaskets, packing materials, and insulation to be used in all U. S. Navy shipboard equipment for both original and replacement applications.

In addition to the above, I understand that I may be asked to testify regarding my opinions and experience regarding various aspects of the design, construction, maintenance, repair, operation, objectives and mission of Navy ships, generally and as they may pertain to the Navy ships in which Charles Krik served and worked.

I have personal knowledge of the types of plans, specifications and requirements that governed suppliers of equipment for use on Navy and Navy designed ships, such as Crane Co. Based upon this knowledge, my experience, and the extensive materials I have reviewed in connection with various Navy ships, I can attest that any work performed on products built and supplied for ships of the U.S. Navy or the U.S. Navy was performed to detailed requirements specified by the Navy or Navy. All work such as that was reviewed and inspected by Navy or other government personnel prior to acceptance by the Navy or Navy to ensure strict compliance of the products with the government specifications.

As a Navy engineering officer and program manager, I was often called upon to assist in determining conformance of shipbuilders and equipment vendors to drawings and specifications prior to acceptance by the Navy. The chain of command within the Navy concerning ship design and construction involves several layers of authority, particularly in the lines of command for technical and contractual control over Navy ship design, construction, maintenance and repair. Ultimately, the Secretary of the Navy has authority over the Navy including Navy shipbuilding design, construction and operation. At the time of construction of the U.S. Navy ships in which Charles Krik served and worked, the Navy Bureau of Ships (BUSHIPS) controlled all Navy ship design and construction and reported to the Chief of Naval Operations as well as to a civilian Assistant Secretary of the Navy. Under the command of BUSHIPS, the Navy's design and shipbuilding organization included several divisions and levels of authority concerning ship design, construction, maintenance, repair and inspection. The Chief of BUSHIPS and the Chief of the Bureau of Supply and Accounts (BUSANDA) maintained and directed technical and contractual control over shipboard equipment. Each of these two organizations had oversight responsibility concerning equipment built for installation or use aboard Navy ships.

In the 1920s and 1930s, complexity and sophistication of the propulsion and weapons systems on warships increased significantly. In order to assure quality and to promote efficiency and effectiveness, the Navy determined that a strict, explicit set of written standards were necessary to control the specifications of all equipment manufactured and supplied to the Navy. As a result, the Navy developed an engineering process for the creation and subsequent modification, as needed, of written specifications outlining all requirements for equipment manufactured and supplied for the Navy's use. Such specifications covered, for example, not only the physical requirements of the equipment, but also, as will be seen below, the nature and the content of written instructions, directions and warnings that would accompany such equipment.

BUSHIPS and BUSANDA had the responsibility to develop the written specifications and standards for the manufacture and supply of equipment used in the construction, maintenance and repair of Navy ships. Specifications for any equipment intended for use aboard Navy ships were drafted, approved and maintained by the Navy. The specifications were intended to address shipboard equipment requirements. Once promulgated, only the Navy could make any changes or modifications to those specifications. BUSHIPS maintained and controlled the specifications largely because it had superior knowledge of the demands and requirements of combat-ready ships.

In the context of ship construction, BUSHIPS and/or BUSANDA prepared contract specifications, which incorporated and referenced the technical specifications. From time to time, privately owned shipyards or marine design professional firms also prepared contract specifications incorporating the Navy's specifications. Whether issued by the Navy or by private entities under contract to and as approved by the Navy, these specifications reflected the contemporaneous state of the art and the special needs of Navy ships, including considerations for the safety and protection of the crew aboard fighting ships.

Navy specifications were communicated to vendors such as Crane Co. when the Navy (or private entities, such as shipyards or design professional firms) issued Invitation for Bids/Request for Proposals for the manufacture or supply of certain equipment. Compliance with the standards and specifications issued for equipment supplied for ultimate use aboard Navy ships was directly monitored by Naval Machinery Inspectors under both of the following divisions: (a) Machinery Inspectors under BUSANDA worked on-site at vendor facilities, such as Crane Co.'s manufacturing facilities; and (b) Machinery Inspectors under BUSHIPS carried out their responsibilities at the shipbuilding yards. The Machinery Inspectors ultimately worked for the Secretary of the Navy or the Secretary of War. These Inspectors exercised primary, front line control and direction over the work performed for the Navy by original equipment manufacturers (OEMs), regardless of whether the equipment was being constructed or supplied pursuant to a Navy or private contract.

BUSHIPS maintained engineers highly qualified in specialty areas such as pumps, valves, steam turbines, boilers and accessories, reduction gears, ship propulsion and auxiliary equipment. In addition, because a majority of the Navy's surface ships used steam turbine engines as a principal form not only of propulsion, but also as a source of power in general, BUSHIPS further maintained significant expertise in the important area of heat transfer and insulation particularly

the use of certain asbestos fibers in insulation materials. These Navy engineers had control over the technical aspects of military specifications that concerned their area of expertise. In addition, BUSHIPS had an Engineering Standards Group to help manage the large number of specifications and contract plans, as well as amendments and updates that existed at any given time. Changes to specifications were continually under review as new technology, construction techniques or other considerations evolved.

Crane Co. equipment could not have been installed in the U.S. Navy ships in which Charles Krik served and worked unless that equipment was first determined by the Navy to be in conformity with all applicable Navy specifications. The Navy specifications governing any products supplied by Crane Co. for the Navy ships required that all gaskets supplied with the products be of a type approved by the Navy for the applications in question. The Navy specifications similarly governed the type of packing materials that could be supplied with products.

In my experience, OEMs, such as Crane Co. would not have been permitted, under the specifications, associated regulations and procedures, nor under the actual practice as it evolved in the field, to vary or to deviate in any respect from the Navy specifications in supplying equipment, including affixing any type of warning or caution statement to equipment intended for installation in a Navy ship, beyond those specifically required by the Navy without prior discussion and express approval by the Navy.

Based upon my knowledge of and experience in the design, inspection and procurement of equipment for use on Navy vessels, the Navy would not have permitted Crane Co. or other equipment suppliers to place asbestos-related health warnings in technical manuals supplied with products for the U.S. Navy ships in which Charles Krik served and worked.

Replacement of the original gaskets and packing within any products supplied by Crane Co. for Navy ships would have typically been accomplished with gaskets and packing from other suppliers, not from Crane Co.. The Navy did not consult with OEMs regarding the supply of replacement materials, such as gaskets and packing that might be used in connection with that equipment. Rather, the Navy procured gasket and packing materials in bulk quantities directly from the manufacturers of such products in accordance with the Navy's then-current standards and specifications.

OEMs were generally not the suppliers of insulation products specified by the Navy for application to the OEM's equipment after installation. Thus, other suppliers – not the OEM – provided insulation products that may have been applied to the original equipment, including valves, pumps, piping, steam strainers, traps, and other equipment after it had been installed and tested. The Navy did not consult OEMs regarding the use or installation of insulation materials that might be installed on that equipment after acceptance by the Navy. Moreover, not only did the OEM not have any control over the type and quantity of insulation product that the Navy specified to be used on its equipment, the OEM would have no knowledge whether or not any insulation would, in fact, be applied to the original equipment due to the variety of circumstances and potential uses of the original equipment by the Navy.

Executed this 15th day of November 2011 at Great Falls, Virginia.

David P. Sargent, Jr.